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ABSTRACT

Two experiments were conducted to examine the possibility that numbering might have an effect on learning of lists composed of more meaningful and highly available materials, words, and to further explore the possibility that different strategies may be employed in learning the two types of lists. In Experiment 1, 40 female students from elementary psychology served as subjects. Two sets of nonoverlapping 11-word serial lists were composed from a set of 22 two-syllable nouns. The words were typed in upper case letters for presentation by memory drum. Each subject learned a nonoverlapping set of 2 lists by the anticipation technique with 4 sec. anticipation and intertrial intervals. In Experiment II, a total of 48 subjects, 24 male and 24 female, from undergraduate psychology classes learned the lists. Subjects were equally distributed by sex over conditions. Two different lists composed of 10 two-syllable nouns were constructed. Each subject learned both lists, half in each order. The results of these two experiments indicate that numbering of serial lists does not improve performance in initial learning. Also, while the present data do not settle the issue of how learning numbered lists differs from the learning of unnumbered lists, they do indicate that there are differences between them. (CK)

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Transfer Effects Between Numbered and Unnumbered Serial Word Lists

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The assumption that the position of an item in a serial list is a functional stimulus for learning has been made by Young (1961). A number of studies have supported this contention, although some have not (cf, Young, 1968). A rather simple hypothesis which may be derived from this notion is that making the position of an item explicit should enhance learning of the list. However, a series of studies using CVC trigrams of middle level meaningfulness performed by Leonard and Tangeman (in press) has indicated that numbered (N) and unnumbered (U) lists are learned equally well. A possible explanation for the failure to find the expected differences is that Ss are capable of providing numbers for the U lists, and thus, do not need an explicit presentation of the numbers. An alternative explanation is that Ss will adopt one strategy to learn N lists and another strategy to learn U lists.

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The experiments reported here were designed to examine the possibility that numbering might have an effect on learning of lists composed of more meaningful and highly available materials, words, and to further explore the possibility that different strategies may be employed in learning the two types of lists.

If Ss provide their own numbers for the U lists, we might expect that transfer effects between N and U lists would be the same. However, if different strategies are adopted for learning the lists, greater transfer might be expected between lists for which the same

strategy is appropriate, e.g. from one N list to another, than between lists for which different strategies are needed, e.g. from an U list to a N list. The present experiments examined transfer in a 2 x 2 factorial design in which type of first list was crossed with type of second list.

Because the finding of negative results is less than conclusive in any experimental task, two highly similar experiments were performed to determine the replicability of the phenomenon.

METHOD

Experiment I

Subjects.--Forty female students from elementary psychology classes served as Ss.

Materials.--Two sets of nonoverlapping 11 word serial lists were composed from a set of 22 two-syllable nouns. The words were typed in upper case letters for presentation by memory drum. Items in the N condition were preceded by the number, a period and a space.

Procedure.--Each S learned a nonoverlapping set of 2 lists by the anticipation technique with 4 sec. anticipation and intertrial intervals. Within each experimental condition, e.g. NN, NU, each set of lists was learned by 5 Ss. The first list was presented for 10 trials, but the second list was learned to a criterion of two consecutive perfect trials. Instructions were the same for all Ss. No mention of numbering was made.

Experiment II

Subjects.--A total of 48 Ss, 24 male and 24 female, from undergraduate psychology classes learned the lists. Ss were equally distributed by sex over conditions.

Materials.--Two different lists composed of 10 two-syllable nouns were constructed.

Procedure.--Each S learned both lists, half in each order. The first list was presented for 8 trials, and the second list was learned to a criterion of one perfect trial. The anticipation and intertrial intervals were 3 sec. All other procedures were the same as in Exp. I.

RESULTS

Experiment I.--On the first list the mean numbers of correct responses for Ss in conditions NN, NU, UN and UU were 81.3, 69.1, 77.1 and 74.1, respectively. A three factor ANOV with first list condition, second list condition and list learned as between S effects produced no significant effect for first list condition, $F(1,32) = 2.70$, $p>.10$. The equality of groups for second list learning was considered quite tenable with $F(1,32)<1$ for both second list condition and first list condition x second list condition interaction. No list effects or interactions were significant.

Two measures of performance on the transfer task were examined. The mean numbers of correct responses on the first 10 trials for Ss in conditions NN, NU, UN and UU were 93.7, 83.9, 87.2, and 95.9 respectively. Those few Ss who reached criterion prior to the tenth trial were credited with all correct responses on trials after reaching criterion. An ANOV calculated with first list condition, second list condition and list learned as factors showed that main effects of first and second list conditions were nonsignificant, both $Fs<1$. However, the first list condition x second list condition interaction was significant, $F(1,32) = 8.06$, $p<.01$. In evaluating simple effects it was found that Group UU performed significantly better than Group NU,

$t(32) = 3.68$, $p<.01$. The UU vs UN comparison was also significant, $t(32) = 2.67$, $p<.025$. The comparison of Group NN with Group NU was significant, $t(32) = 3.01$, $p<.01$, but the NN vs UN comparison just failed to reach an acceptable level of significance, $t(32) = 2.00$, $.10>p>.05$.

The trials to criterion measure produced results which were highly similar to those obtained with the correct response measure. The means of trials to criterion were 7.3, 8.8, 9.7 and 6.4 for Groups NN, NU, UN and UU, respectively. The main effects of conditions for both the first list and the second list produced Fs<1, but the interaction was significant, $F(1,36) = 4.21$, $p<.05$. No comparisons of simple effects reached significance reflecting the poorer sensitivity of the trials to criterion measure.

Experiment II.--The mean numbers of correct responses on the first list for Groups NN, NU, UN and UU were 44.58, 52.33, 51.42 and 60.50, respectively. The effects of first list condition, $F(1,44) = 4.52$, $p<.05$ and second list condition, $F(1,44) = 5.70$, $p<.05$ were both significant. Thus, it was considered necessary to utilize a covariance analysis on the data for second list learning. Because a number of Ss learned the second list very rapidly the measure used was number of correct responses on the first 4 trials. The correlations between first list learning and second list learning for the four groups ranged from .35 to .83. Although the small numbers of cases made the power of a test of equality of regression coefficients so low as to be useless, examination of the scatter diagrams indicated that the differences in correlations were probably based on error variance. No significant main effects were found in the covariance analysis. However, again the first list condition x second list

condition interaction was significant, $F(1,43) = 4.64$, $p<.05$. The adjusted means of numbers of correct responses for Groups NN, NU, UN and UU were 25.46, 20.79, 24.12 and 25.89, respectively. Only the differences between NN and NU, $t(43) = 2.15$, $p<.05$, and between UU and NU, $t(43) = 2.34$, $p<.05$, were significant. A covariance analysis of trials to criterion indicated no significant effects, again reflecting the lower sensitivity of that measure.

DISCUSSION

It is obvious from the results of these experiments that numbering of serial lists does not improve performance in initial learning. While the finding of significantly more correct responses on the first unnumbered list in Exp. II might suggest that the numbering degrades performance, data from other experiments which will be published elsewhere do not replicate that finding. Thus, it can most likely be considered a sampling problem.

The fact that performance on the transfer task was inferior for the change groups could be attributed to task generalization decrement. This argument implies that Ss are in some way treating the lists differently.

Several possibilities can account for the failure to find initial differences in favor of the numbered lists. The simplest possibility is that Ss do not attend to the numbers. However, such an explanation seems to be ruled out by the differential transfer effects. A second possibility is that Ss presented with numbers use them, but develop a different strategy than that developed by Ss who learn the unnumbered lists. For example, a type of paired associate strategy might be developed in which the response is given to the number. This would, of course, require incrementing the number which

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was appearing by one to obtain the stimulus for the next response. This would reduce the time for learning the responses. Consequently, the benefits from numbering might be cancelled by the reduction in time for making associations. In addition, some interference might occur between the item occuring simultaneously with the number and the item which is the correct response to be made while that number is present.

It is also possible that the basic strategies of learning are the same and that numbering aids learning by making position more explicit, but that Ss are learning number and word as a unit which reduces the amount of time spent on the associative hookup. This argument also suffers from the finding of differential transfer, since if the basic strategies are the same, the NU groups should perform as well as the UU groups.

Although the finding from Exp. I that Group UN did not perform as well as Group NN was not replicated in Exp. II, it must be considered a possible true effect pending additional data. This gives some weight to the differential strategy hypothesis. If Ss are using the same basic strategy in both conditions N and U, there should be no more time lost in learning number and word as a unit for Group UN than for Group NN. However, if a differential strategy is adopted because Ss are presented the position numbers, then the time taken to develop the new strategy could degrade performance for both Groups UN and NU.

While the present data do not settle the issue of how learning numbered lists differs from the learning of unnumbered lists, they do indicate that there are differences between them.

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